

DIVISION 14 LIGHTING

SECTION 1400 ROADWAY LIGHTING

1400-1 DESCRIPTION

Furnish, install, connect and place into satisfactory operating condition lighting at locations shown in the plans. Perform all work in accordance with the contract and the National Electrical Code.

This division is for methods, materials and equipment to construct and put in working order the proposed lighting; however, every fitting, minor detail, or feature may not be shown or described. The Contractor shall be an expert in the trade, capable of understanding the intent of the contract and constructing the lighting and electrical system(s) in accordance with the best practice of the trade.

The Contractor actually performing the work described in the contract shall have a license of the proper classification from the North Carolina State Board of Examiners of Electrical Contractors.

Have the licensed Contractor available on the job site as necessary when work is being performed or when requested by the Engineer. Have this Contractor possess a set of project plans and Specifications on the job site and maintain a set of accurate as built plans. This Contractor shall be qualified to responsibly instruct and direct all employees regarding the electrical work.

1400-2 MATERIALS

Refer to Division 10.

Item	Section
Conduit	1091-3
Ground Rod	1091-6
Wire	1091-2

(A) General

All materials used in the work are to be new materials unless noted elsewhere in the contract. References in the contract to any proprietary device, product, material, fixture, form, type of construction, etc. by make or catalog number, with or without the words or approved equal, is to be taken as establishing a standard of quality and is not to be construed as limiting competition. In such case, the Contractor may use any material, equipment or type of construction which has written approval as being an acceptable equal to that named for the particular use intended by the contract.

Provide materials that are labeled or listed by an acceptable organization, which is defined as an organization that maintains periodic inspection of the production of the materials and verifies, by the labeling or listing procedure, that the materials comply with appropriate standards of performance or are suitable for use in a specified manner. Provide Underwriters' Laboratories (UL) labeled and listed materials when such labeling and listing is available for such materials.

Make sure that materials are in compliance with requirements for use of domestic products, as specified in other sections of the Specifications.

Section 1400

(B) Conduit

Use conduit and duct that is either metallic (Rigid Metallic Conduit) or non-metallic (PVC or HDPE), as noted in the plans.

(C) Wire

Use stranded copper conductors unless specifically noted otherwise on the contract. Use wire and cable which conforms to IPCEA specifications and has marks for identification (manufacturer's name, type insulation and gauge of conductor) and the UL label.

Use wire insulation rated at 600 VAC or greater.

Use the following types of wiring unless noted otherwise in the plans:

Service Lateral	UL Type USE
Control System	UL Type THW or RHW or THHN
Feeder Circuits in Conduit	UL Type USE
Branch Circuits in Light Standards	UL Type SO Cable
Equipment Grounding Conductor	Solid MHD, Bare or Insulated
Grounding Electrode Conductor	ASTM B2

Use #6 AWG for the grounding electrode conductor unless noted larger in the plans.

(D) Grounding and Bonding Equipment

Use ground rods which are 5/8" diameter x 10 ft copper clad steel. Permanently bond grounding conductor to ground rod using exothermic weld. Make sure that all grounding and bonding equipment conforms to UL Standard 467.

(E) Fuseholders

Provide fused overcurrent protection in the base of each light standard and other locations as noted. Use a fuseholder rated at least 600 VAC and 30 A approved for wet locations, constructed so the fuse will be disconnected from the line side power every time the fuseholder is opened. The fuseholder may be made of molded plastic or rubber and have insulating boots. Use terminals which are specifically rated for the size and number of conductors required.

Use fuses which have 5,000 A minimum interrupting capacity at the supply voltage, are rated 10 A or as noted in the plans and are not glass type unless specified different in the contract. Use the same type fuse in all fuseholders on a project unless specified differently at specified locations.

Use fuseholders specifically designed as breakaway devices in fiberglass standards and standards with breakaway bases. Use fuseholders designed to disconnect line side power without damage to the terminals or conductors every time sufficient pulling force is placed on the line and load side conductors.

(F) Hardware

Use mounting or attachment hardware including bolts, nuts, washers, straps, clamps and hangers which is made of stainless steel, hot dipped galvanized or of equal corrosion resistance. Use bolts, which are minimum length and are not less than one nominal size smaller than the opening being used.

(G) Lamps

Use lamps that conform to ANSI specifications, are of the type and wattage indicated on the contract, are rated for a minimum of 24,000 hours life, have a mogul base and have special coatings for premium efficiency and color rendition. Provide and install same type lamps for all same type luminaires furnished on the project.

(H) Duct and Conduit Sealer

Use duct and conduit sealer or mastic which is a putty-like compound and complies with the following:

- (1) Is permanently non-hardening, non-oxidizing and non-corrosive to metals, rubber, plastic, lacquer and paints;
- (2) Is readily workable for thumbing into openings and forming into seals around wires inside conduits and openings around conduits;
- (3) Has a service temperature range of minus 30°F to 200°F;
- (4) Is clean, non-poisonous and non-injurious to human skin; and
- (5) Seals against water, dust and air and shall adhere to wood, glass, plastics, metal, rubber and painted surfaces.

(I) Pull Lines

Place pull lines specifically designed for pulling a rope in all empty conduits and electrical duct so that electrical circuits can be installed in the future. Use pull lines which are 2 ply with a tensile strength of at least 240 lb and resistant to tangling, rot and mildew.

1400-3 SUBMITTALS**(A) Catalog Cuts**

Submit for approval catalog cuts and/or shop drawings for materials proposed for use on the project. Allow 40 days for review of each submittal. Do not deliver materials which have not been approved to the project. Submit 8 copies of each catalog cut and/or drawing and show for each the material description, brand name, stock-number, size, rating, manufacturing specification and the intended use.

Three copies of approved submittals will be returned to the Contractor. Present a catalog cut or drawing for all components of each contract item. Present the submittals neatly arranged in the same order as the contract bid items.

(B) Certifications

Furnish a Type 3 material certification in accordance with Article 106-3 for light standards, high mounts and lowering devices and a Type 6 material certification for conductors. Submit certifications when the above materials are delivered to the project.

Type 3 or Type 6 material certifications in accordance with Article 106-3 may be requested for any or all of the other material which does not have a name plate showing sufficient information to verify that the material was manufactured to the requirements of this section.

(C) Samples

Random samples will be taken of the various items for the purpose of verifying conformance with Specifications. The selection of the items to be sampled and the taking of the samples will be done by the Engineer.

Failure to meet specification requirements by 2 samples of any material will be sufficient reason for rejection of all materials from the same lot.

Upon request, there will be reimbursement for the actual verified cost of such material taken as samples, including any handling charges less any discount allowed on the invoice, but with no percentage added, and such material will thereafter become the property of the Department.

Section 1400

(D) As-Built Plans

Submit 2 complete sets of as-built plans for review upon completion of the work, showing the location of all buried electrical circuits, with pavement crossings dimensioned from fixed objects or from survey stations.

Include in the as-built plans the title (No. 1), index (No. 1A), summary of quantities (No. 3) and all of the layout and detail (E) sheets of the project with all changes indicated. After review and approval, place one set of these as-built plans in a waterproof envelope and file in each control panel.

Submit one set of as-built plans to the Roadway Design Unit.

Show the light standard foundations that are relocated (by permission of the Engineer) on the as-built plans in their final locations.

Keep a daily record of the location of all items in order to ensure the accuracy of the as-built plans.

(E) Warranties

Turn over warranties from each manufacturer of electrical materials and equipment pertinent to the complete and satisfactory operation of the system before the acceptance of the project. Indicate the expiration date on each warranty furnished. The warranty shall not be less than those provided as a customary trade practice.

(F) Computations and Welding Procedures

Submittals of structural design computations and drawings showing material and welding specifications, as required in other sections of the *Standard Specifications* such as High Mount Standards, may require 10 weeks for review.

1400-4 CONSTRUCTION METHODS

(A) Location Surveys

All light standards, high mount foundations and electrical duct will be located unless indicated differently elsewhere in the contract. Mark the proposed location of circuits, circuit markers, control systems, service poles, junction boxes, luminaires and all other components for approval before installation.

The plan locations of the light standards and high mounts may be adjusted to be behind guardrail, to avoid obstructions or to avoid undesirable foundation conditions. Ensure location changes are approved before construction. Light standards can be moved no more than 10 ft longitudinally and 2 ft laterally unless approved by the Special Design Section of Roadway Design Unit. High mast light standards can be moved no more than 25 ft radially unless approved by the Special Design Section of Roadway Design Unit.

Verify project dimensions on the site, actual measurement always taking precedence over scaled plan dimensions, with every part of the work fitted to actual conditions at the site.

(B) Damage to Facilities

Take all precautions necessary to avoid damage to existing underdrains and other buried facilities located in certain areas. Hand trenching may be required to avoid damage to the underdrains, storm sewer systems and other facilities. Construct light pole foundations with a minimum horizontal clearance of 10 ft to storm sewers or other underground installations which might affect the foundation stability. Make lateral and longitudinal changes in pole locations in the field to provide the required clearance, as directed.

Trenching and construction operations may require the removal of, or result in damage to, existing shoulders and paved ditches. Restore all disturbed portions of the project to their original condition or as approved.

Installation of conductors may require trenching through existing guardrail locations. Trenching may be done beneath the guardrail in a manner that will not disturb the guardrail installation or the Contractor may remove short sections of guardrail to facilitate mechanical trenching. Reinstall all removed guardrail by the end of the day's work. Permission is required before removal of any guardrail. Repair any damage to the guardrail installation or to the galvanizing of the material as directed.

Repair all trenched, excavated, or otherwise damaged earth surface areas by shaping, smoothing, seeding and mulching the damaged areas as required by the Specifications and as directed.

(C) Existing Utilities

Water, sewer, telephone, fire alarm, traffic signal and power lines may be located in the same area that lighting standards and circuits are to be installed.

Locate these lines before operations are begun. Field changes approved by the Engineer may be made to provide clearance required by the NESC.

Foundations or other construction which is installed in conflict with existing utilities will not be acceptable. Remove unacceptable conflicting construction and repair damage to utilities at no cost to the Department.

When the work involves replacing or renovating existing lighting, make all reasonable efforts to prevent dark spots in the lighting system. Phase lighting construction to allow existing lighting to remain in operation as long as possible.

(D) Operation of Equipment

Use a bucket truck to raise workers into position to install and/or adjust luminaires and lamps after the initial setting of the standards. Taking down the light standard to check or make adjustments at the top is not allowed.

Install all bore pits outside the clear zone.

(E) Conduit Installation

Install conduit continuous, watertight, free of kinks and make all runs with as few couplings as standard lengths will permit. Do not exceed a total angle of 270° between outlets unless otherwise approved. Conduit bodies with covers and neoprene gaskets may be used to facilitate the installation of the wires at locations indicated in the plans.

Provide protection at all times against the entrance of water or other foreign matter into the conduit. Plug or cap conduit when work is temporarily suspended, including nightly stoppage of work.

Clean all conduits before installation and upon completion of the system. Snake an approved cleaner with a diameter not less than 85% of the nominal diameter of the conduit through each conduit before installing the wire.

Install the conduit in such a manner that temperature changes will not cause elongation or contraction that might damage the system. Provide expansion fittings where conduit crosses structure expansion joints and at other locations shown in the plans.

Avoid short radius bends in non-metallic conduit to prevent burn-through of the pulling cable or conductors during pulling operations.

Install caps or plugs on stub-outs for future use. Caps and plugs shall be made of the same material as the conduit. Where non-metallic conduit is joined to metallic conduit, use a transition adapter. Install bushings on all conduit ends projecting into panels, boxes, or other enclosures. Provide pull lines in all conduits for future installation of circuitry. Coat field cut threads and other uncoated metal or damaged galvanizing with organic zinc repair paint. Securely fasten conduit. For the spacing of fasteners,

Section 1400

do not exceed 4 ft for 1 1/2" conduit and larger or 6 ft for 1 1/4" conduit and smaller. Use fasteners that are hot dipped galvanized or stainless steel. Provide backs with all conduit straps installed on flat surfaces. Rotary-impact drills may be used for installing expansion anchors in concrete. Do not use powder explosion type units.

Do not install underground conduit until the area has been brought to final earth grade. Give careful attention to the vertical and horizontal alignment of the conduit to provide the smoothest installation.

(F) Wiring Methods

Do not pull wire through a conduit system until the system is complete and has been cleaned. Use approved wire pulling lubricants. Pull conductors by hand, or use motorized cable-pulling equipment designed for pulling multiple cables into conduit. Use sheaves or rollers, as required to prevent damage to conductor insulation. Do not use an automobile to generate cable pulling forces. Use equipment similar to the Greenlee model UT2 cable pulling system, or Engineer approved equal.

Color code all conductors per the NEC (grounded neutral is white, grounding is bare or green) and use phase conductors which are black and red. Approved marking tape, paint, or sleeves may be used instead of continuous colored conductors for No. 8 AWG and larger. Do not mark a white conductor in a cable assembly any other color. White, red or black conductor may be stripped at all accessible points and used as a bare equipment grounding conductor.

Joints, taps and splices will only be permitted at locations indicated in the plans and by the following method.

Install a manufactured set screw type connector, suitable for connecting multiple wires and are UL Listed (UL486D). These precise fit connectors are insulated with high-strength dielectric material and equipped with factory made waterproof insulating boots and removable access plugs over the set screws. These connectors are suitable for use in direct burial and submersible applications. Tape down the access plugs to keep them securely in place. Split-bolt, wire nut and compression type connectors will not be allowed.

All splices inside light standards shall be easily accessible through handholes unless standard is mounted on breakaway transformer base.

(G) Grounding Electrodes

Install grounding electrodes at each light standard, high mast light standard and control system as shown in the plans. The rod shall be driven vertically until the top is 6" below the ground surface. The grounding conductor must be connected to the grounding electrode by exothermic weld.

(H) Equipment Mounting

Mount equipment securely at locations shown in the plans in conformance with the dimensions shown and make vertically plumb and level. Install fasteners as recommended by the manufacturer and space evenly. Use all mounting holes and attachment points for attaching enclosures to structures.

(I) Base Protection

For median mounted light standards, use a protective metal shroud installed underneath the light standard base plate to protect the exposed anchor bolts and lighting circuitry segments between the base plate and the top of the concrete median barrier. The metal shroud shall be fabricated of either galvanized steel, minimum gauge 22, or aluminum, minimum gauge 18, to match the material type of the light standard. The metal shroud shall be composed of 2 overlapping pieces, and attached with 2 self-tapping stainless steel or galvanized machine screws at each overlap point.

For high mount standard, use galvanized steel welded wire reinforcement between the top of foundation and bottom of mounting base. Attach welded wire reinforcement to anchor bolts with size AWG 14 copper wire or small gauge galvanized wire.

(J) Galvanizing Repair

Repair any damaged galvanized components in accordance with Article 1076-7.

1400-5 ELECTRICAL INSPECTIONS AND TESTING

Comply with all local ordinances and regulations. Apply for and obtain all permits and/or licenses required by local regulation.

Provide a calibrated MegOhmMeter, with certification that calibration was done within one year of use. Provide a meter manufactured by Fluke, Amprobe, Biddle or Engineer approved equal. Present the meter for inspection, at the Pre-Lighting-Work meeting described in Section 1400-11.

During project construction the Contractor will perform an insulation resistance test on each feeder circuit conductor. The insulation resistance for each conductor shall exceed 5 megaohms after charging for 30 seconds at 500 VAC or 1000 VDC. A copy of the Contractor Meg Circuit Data Form is available on the Roadway Design Unit website. The data form will be completed by the Contractor and submitted to the Lighting and Electrical Squad of the Roadway Design Unit for review before final inspection.

If the insulation resistance test of any conductor indicates a value of less than 5 megaohms, locate the fault. If the fault is in a conductor between terminal connections, replace the conductor. If the fault is at a terminal connection, repair or replace the terminal device.

Removing water from the conduit of a faulty circuit is not considered a repair. Water in the conduit allows electric current to flow between skinned places in the conductors insulation. If a circuit fails the insulation resistance test and removing water allows the circuit to pass, replace the conductors and re-test the new circuit.

After all control system cabinet wiring has been installed and connected in the proposed permanent manner the Contractor will contact the Office of State Fire Marshall of the Department of Insurance, or local authority having jurisdiction, to perform an electrical inspection of the lighting system. Upon satisfactory testing, the Contractor will be issued a Certificate of Inspection for the lighting system. The Contractor may then arrange with the power company to provide the necessary power service. The Certificate of Inspection will be turned over to the Engineer before project acceptance. Inspection by local authorities will neither eliminate nor supersede the final inspection by the Engineer to ensure compliance with the contract.

Have all work inspected and approved by the Engineer before concealment. An inspection will be made during the progress and after the work has been completed. It will also include an inspection made at night to determine the optical qualities of each luminaire. Adjust all luminaires having unsatisfactory qualities as directed.

Provide the necessary personnel and equipment for aiming luminaires during nighttime inspections by the Engineer.

The Engineer should contact either the Special Design Section or the Lighting and Electrical Squad of Roadway Design Unit to schedule a final inspection of lighting systems at least 2 weeks before the requested inspection date. The Lighting and Electrical Squad will perform an insulation resistance test as described above, inspect the system for adherence to contract requirements and prepare a lighting inspection memo based on the Lighting System Inspection Checklist. A copy of the inspection checklist is available on the Roadway Design Unit's website. The Contractor is responsible for providing the personnel and equipment necessary for removing and replacing fuseholders and/or operating circuit breakers to facilitate the insulation resistance test performed by the Lighting and Electrical Squad.

Section 1400

1400-6 BURN-IN TEST

After all the issues mentioned in the lighting inspection punchlist are addressed to the satisfaction of the Engineer, the lighting system will undergo a 2-week burn-in test. The burn-in test consists of normal dusk to dawn operation of all lighting system control equipment and apparatus, without interruption or failure attributable to poor workmanship or defective material. At the end of the burn-in test, all lights and equipment will be inspected for normal operation. The Contractor will make any necessary repairs or replacements at no cost to the Department.

Conduct the burn-in test at the same time for all lights which are energized from the same utility company service point.

Burn-in tests of individual circuits or groups of lights will not be acceptable.

1400-7 IDENTIFICATION

Identify each component of the lighting/electrical system as indicated in the plans. Use a method of identification which includes an approved paint, adhesive label, heat shrink label or embossed concrete. Label conductors on components requiring identification at each terminal, circuit breaker, light standard, high mount standard, control system, junction box and underpass panel.

Label each circuit conductor at each terminal and access point with the circuit number indicated in the plans.

Identify light standards and high mount standards by the control system and location number indicated in the plans. Put the identification on the front side of the standard facing the traffic at a height of 6 ft above ground level. Identify control systems and underpass panels on the exterior of the front panel.

1400-8 LOCKS AND KEYS

Supply all access doors to control cabinet enclosures with locks that meet the Engineer's approval. Key all locks alike and furnish 8 keys to the Engineer.

1400-9 ELECTRICAL SERVICE

Coordinate all work to ensure that electrical power of the proper voltage, phase, frequency and ampacity is available to complete the project. Contact the utility company, make application, pay all deposits and other costs to provide necessary electrical service. The Contractor will be reimbursed for the actual verified cost of any utility company charges.

The Engineer will provide authorization to the Contractor for electrical service to be obtained in the name of the Department and for the monthly power bills to be sent directly from the utility company to the Department. The Department will be responsible for direct payment of monthly power bills received from the utility company.

1400-10 TERMINOLOGY

The terms "High Mast" and "High Mount" are used synonymously in the contract.

The term "By Others" means work to be accomplished and paid under contract items other than those clearly pertaining to the work specified or shown. Work by others may be included in this contract for the Contractor to provide, or it may be provided under another contract or by someone other than the Contractor.

Abandon means that the materials will not be used in the final completed form of the work. Remove all abandoned materials from the project or terminate at least 18" below subgrade so they will not be in conflict with the finished project.

1400-11 CONSTRUCTION PHASING

Schedule a Pre-Lighting-Work meeting before beginning work on the lighting system. Include staff members from the prime contractor, electrical sub-contractor, Resident Engineer's office and the Lighting and Electrical Squad in the Roadway Design Unit in Raleigh

Accomplish lighting work along with other roadway construction in the appropriate phases as indicated in the Traffic Control Plans and these Specifications.

1400-12 MEASUREMENT AND PAYMENT

There will be no direct payment, except where specifically noted in the Subarticle 1400-3(C) and Article 1400-9 for the work required in the preceding sections of this division. Payment of the contract unit prices for the various items in the contract will be full compensation for all work required.

1400-13 CONTRACTOR MEG CIRCUIT DATA FORM

The Electrical Sub-contractor is responsible for completing the Meg Circuit Form and submitting the insulation resistance data to the Lighting and Electrical Squad of Roadway Design Unit for review before final inspection. A copy of the Contractor Meg Circuit Data Form is available on the Roadway Design Unit's website.

1400-14 LIGHTING SYSTEM INSPECTION CHECKLIST

The Engineer is responsible for scheduling the lighting system final inspection by contacting either the Special Design Section or the Lighting and Electrical Squad of the Roadway Design Unit. The Lighting and Electrical Squad will coordinate with project inspector and electrical subcontractor to have the checklist items inspected during the final inspection and in preparation of the lighting inspection punchlist. A copy of the inspection checklist is available on the Roadway Design Unit's website.

SECTION 1401 HIGH MOUNT STANDARD

1401-1 DESCRIPTION

Design, furnish and install a high mount standard 60' or greater in height with a top-latched lowering device and portable drive unit including the drive, winch, wiring, cables, brackets, hardware, transformer, power cord, storage case and operating manuals.

1401-2 MATERIALS**(A) High Mount Standard**

Provide certified computations and fabrication drawings by a professional engineer licensed in the State of North Carolina.

Design the support including base plate and anchorage in conformance with the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Fourth Edition, 2001* and the Interim Specifications valid at the time of letting. Use Fatigue Category II. Design and fabricate welds in accordance with Article 1072-18. Design the support for the wind velocity shown in the plans.

Have the drawings show all details relating to pole, access hole, base, anchorage and lowering device. Show references to ASTM specifications or to other material specifications for each type of material used on the drawings. Note the total weight in pounds on the drawings for each component and the total assembly. Make sure that all drawings are clearly identified with a drawing number and signed and dated by the manufacturer's authorized representative.